

10/521/138

SEQUENCE LISTING

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Governors of the University of Alberta

<120> Synthesis of Oligosaccharides, Glycolipids and
Glycoproteins Using Bacterial Glycosyltransferases

<130> 019957-015920US

<140> US 11/521,138

<141> 2005-01-11

<150> US 60/398,156

<151> 2002-07-23

<150> US 60/424,894

<151> 2002-11-08

<150> WO PCT/US03/23057

<151> 2003-07-23

<150> WO PCT/US03/23155

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<170> PatentIn Ver. 2.1

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<213> Helicobacter pylori

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<213> Helicobacter pylori

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<223> Helicobacter pylori strain 1182 FutB

alpha-1,3/4-fucosyltransferase

<400> 2

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Lys Ile Thr Ser Lys Ser Pro Pro Pro Leu Lys Ile Ala Val Ala Asn
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Trp Trp Gly Asp Glu Glu Val Glu Glu Phe Lys Lys Asn Ile Leu Tyr
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Phe Ile Leu Ser Gln His Tyr Thr Ile Thr Leu His Gln Asn Pro Asn
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Glu Pro Ser Asp Leu Val Phe Gly Ser Pro Ile Gly Ser Ala Arg Lys
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Ile Leu Ser Tyr Gln Asn Ala Lys Arg Val Phe Tyr Thr Gly Glu Asn
          85             90             95

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Glu Ser Pro Asn Phe Asn Leu Phe Asp Tyr Ala Ile Gly Phe Asp Glu
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Leu Asp Phe Arg Asp Arg Tyr Leu Arg Met Pro Leu Tyr Tyr Asp Arg
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Leu His His Lys Ala Glu Ser Val Asn Asp Thr Thr Ser Pro Tyr Lys
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Leu Lys Pro Asp Ser Leu Tyr Ala Leu Lys Lys Pro Ser His His Phe
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Pro Leu Lys Arg Gly Phe Ala Ser Phe Val Ala Ser Asn Pro Asn Ala
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Pro Lys Arg Asn Ala Phe Tyr Asp Val Leu Asn Ser Ile Glu Pro Val
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 260 265 270
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 275 280 285
 Glu Ala Ile Asp His Val Arg Tyr Leu His Thr His Pro Asn Ala Tyr
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 Tyr Phe Tyr Gln Asn Leu Ser Phe Lys Lys Ile Leu Asp Phe Phe Lys
 325 330 335
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 340 345 350
 Tyr Arg Asp Leu Asn Glu Pro Leu Ile Ser Ile Asp Asp Asp Leu Arg
 355 360 365
 Val Asn Tyr Asp Asp Leu Arg Val Asn Tyr Asp Asp Leu Arg Val Asn
 370 375 380
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 385 390 395 400
 Asp Leu Arg Val Asn Tyr Asp Asp Leu Arg Val Asn Tyr Asp Asp Leu
 405 410 415
 Arg Val Asn Tyr Asp Asp Leu Arg Val Asn Tyr Asp Asp Leu Arg Val
 420 425 430
 Asn Tyr Asp Asp Leu Arg Val Asn Tyr Glu Arg Leu Leu Gln Asn Ala
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<210> 3

<211> 1299

<212> DNA

<213> *Helicobacter pylori*

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<223> *Helicobacter pylori* strain 1111 FutA
 alpha-1,3/4-fucosyltransferase

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<213> Helicobacter pylori

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<220>
<223> Helicobacter pylori strain 1111 FutA
alpha-1,3/4-fucosyltransferase

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Lys Trp Pro Leu Asn Leu Pro Pro Leu Lys Ile Ala Val Ala Asn Trp
          20             25             30

Trp Gly Asp Glu Glu Ile Lys Lys Phe Lys Lys Ser Val Leu Tyr Phe
          35             40             45

Ile Leu Ser Gln His Tyr Thr Ile Thr Leu His Arg Asn Pro Asp Lys
          50             55             60

Pro Ala Asp Ile Val Phe Gly Asn Pro Leu Gly Ser Ala Arg Lys Ile
          65             70             75             80

Leu Ser Tyr Gln Asn Ala Lys Arg Val Phe Tyr Thr Gly Glu Asn Glu
          85             90             95

Val Pro Asn Phe Asn Leu Phe Asp Tyr Ala Ile Gly Phe Asp Glu Leu
          100            105            110

Asp Phe Arg Asp Arg Tyr Leu Arg Met Pro Leu Tyr Tyr Ala Tyr Leu
          115            120            125

His Tyr Lys Ala Glu Leu Val Asn Asp Thr Thr Ser Pro Tyr Lys Leu
          130            135            140

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 Arg Arg Asn Ala Phe Tyr Glu Ala Leu Asn Ala Ile Glu Pro Val Ala
 195 200 205
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 210 215 220
 Ser Glu Phe Leu Ser Gln Tyr Lys Phe Asn Leu Cys Phe Glu Asn Thr
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 Gln Gly Tyr Gly Tyr Val Thr Glu Lys Ile Ile Asp Ala Tyr Phe Ser
 245 250 255
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 260 265 270
 Asn Pro Lys Ser Phe Val Asn Val His Asp Phe Asn Asn Phe Asp Glu
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 Asp Met His Tyr Glu Asn Pro Leu Asn Thr Ile Asp Gly Lys Ala Tyr
 305 310 315 320
 Phe Tyr Gln Asn Leu Ser Phe Lys Lys Ile Leu Asp Phe Phe Lys Thr
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 385 390 395 400
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<212> DNA

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alpha-1,3/4-fucosyltransferase

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<212> PRT

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          20                      25                      30

Trp Trp Gly Asp Glu Glu Val Glu Glu Phe Lys Lys Asn Ile Leu Tyr
          35                      40                      45

Phe Ile Leu Ser Gln His Tyr Thr Ile Thr Leu His Gln Asn Pro Asn
          50                      55                      60

Glu Pro Ser Asp Leu Val Phe Gly Ser Pro Ile Gly Ser Ala Arg Lys
          65                      70                      75                      80

Ile Leu Ser Tyr Gln Asn Ala Lys Arg Val Phe Tyr Thr Gly Glu Asn
          85                      90                      95
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		115					120					125				
Leu	His	His	Lys	Ala	Glu	Ser	Val	Asn	Asp	Thr	Thr	Ser	Pro	Tyr	Lys	
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Pro	Leu	Lys	Arg	Gly	Phe	Ala	Ser	Phe	Val	Ala	Ser	Asn	Pro	Asn	Ala	
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Ser	His	Thr	Ile	Pro	Ile	Tyr	Trp	Gly	Ser	Pro	Ser	Val	Ala	Gln	Asp	
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Asn	Tyr	Asp	Asp	Leu	Arg	Val	Asn	Tyr	Asp	Asp	Leu	Arg	Val	Asn	Tyr	
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Val Asn Tyr Asp Asp Leu Arg Val Asn Cys Asp Asp Leu Arg Val Asn
420 425 430

Tyr Asp Asp Leu Arg Val Asn Tyr Glu Arg Leu Leu Gln Asn Ala Ser
435 440 445

Pro Leu Leu Glu Leu Ser Gln Asn Thr Thr Phe Lys Ile Tyr Arg Lys
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Ala Tyr Gln Lys Ser Leu Pro Leu Leu Arg Ala Ala Arg Lys Leu Ile
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Lys Lys Leu Gly Leu
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alpha-1,3/4-fucosyltransferase

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20 25 30

Pro Leu Asp Lys Arg Glu Ser Lys Gly Phe Arg Lys Lys Phe Ile Leu
35 40 45

His Phe Ile Leu Ser Gln His Tyr Thr Ile Ala Leu His Arg Asn Pro
 50 55 60
 Asp Lys Pro Ala Asp Ile Val Phe Gly Asn Pro Leu Gly Ser Ala Arg
 65 70 75 80
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 Glu Leu Asp Phe Arg Asp Arg Tyr Leu Arg Met Pro Leu Tyr Tyr Asp
 115 120 125
 Arg Leu His His Lys Ala Glu Ser Val Asn Asp Thr Thr Ala Pro Tyr
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 145 150 155 160
 Phe Lys Glu Asn His Pro His Leu Cys Ala Leu Ile Asn Asn Glu Ile
 165 170 175
 Asp Pro Leu Lys Arg Gly Phe Ala Ser Phe Val Ala Ser Asn Pro Asn
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 210 215 220
 Asn Lys Asn Glu Phe Leu Ser Gln Tyr Lys Phe Asn Leu Cys Phe Glu
 225 230 235 240
 Asn Thr Gln Gly Tyr Gly Tyr Val Thr Glu Lys Ile Ile Asp Ala Tyr
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 alpha-1,3/4-fucosyltransferase

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 alpha-1,3/4-fucosyltransferase

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 35 40 45
 Ala Asp Ile Val Phe Gly Asn Pro Leu Gly Ser Ala Arg Lys Ile Leu
 50 55 60
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 65 70 75 80
 Pro Asn Phe Asn Leu Phe Asp Tyr Ala Ile Gly Phe
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 alpha-1,3/4-fucosyltransferase

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 atgttccaac ccctattaga cgcctttata gaaagcgctt ccattgaaaa aatggcctct 60
 aaatctcccc cccccccct aaaaatcgct gtggcgcaatt ggtggggaga tgaagaaatt 120
 aaagaattta aaaagagcgt tctttatttt atcctaagcc aacgctacgc aatcaccctc 180
 caccaaaacc ccaatgaatt ttcagatcta gtttttagca atcctcttgg agcggctaga 240
 aagattttat cttatcaaaa cactaaacga gtgttttaca ccggtgaaaa cgaatcacct 300
 aatttcaacc tctttgatta cgccataggc tttgatgaat tggattttta tgatcgttat 360
 ttgagaatgc ctttgtatta tgcccatttg cactataaag ccgagcttgt taatgacacc 420
 actgcgccct acaaactcaa agacaacagc ctttatgctt taaaaaaacc ctctcatcat 480
 tttaaagaaa accaccctaa tttgtgcgca gtagtgaatg atgagagcga tcttttataa 540
 agaggggttg ccagttttgt agcgagcaac gctaacgctc ctatgaggaa cgctttttat 600
 gacgctctaa attccataga gccagttact gggggaggaa gtgtgagaaa cacttttaggc 660
 tataagggtg gaaacaaaag cgagttttta agccaataca agttcaatct ctgttttgaa 720
 aactcgcaag gttatggcta tgtaaccgaa aaaatccttg atgcgtatct tagccatacc 780
 attcctatct attgggggag tcccagcgtg gcgaaagatt ttaaccctaa aagttttgtg 840
 aatgtgcatg atttcaacaa ctttgatgaa gcgattgatt atatcaaata cctgcacacg 900
 cacccaaacg cttattttaga catgctctat gaaaaccctt taaacaccct tgatgggaaa 960
 gcttactttt accaagattt gagtttttaa aaaatcctag atttttttaa aacgatttta 1020
 gaaaacgata cgatttatca caaattctca acatctttca tgtgggagta cgatctgcat 1080
 aagccggttag tatccattga tgatttgagg gttaattatg atgatttgag ggtaattat 1140
 gaccggcttt tacaaaacgc ttgcctttta ttagaactct ctcaaaacac cactttttaa 1200
 atctatcgca aagcttatca aaaatccttg cctttgttgc gcgcggtgag aaagttgggt 1260
 aaaaaattgg gtttgttaa 1278

<210> 12
 <211> 425
 <212> PRT
 <213> Helicobacter pylori

<220>
 <223> Helicobacter pylori strain 26695 FutA
 alpha-1,3/4-fucosyltransferase

<400> 12
 Met Phe Gln Pro Leu Leu Asp Ala Phe Ile Glu Ser Ala Ser Ile Glu
 1 5 10 15
 Lys Met Ala Ser Lys Ser Pro Pro Pro Pro Leu Lys Ile Ala Val Ala
 20 25 30
 Asn Trp Trp Gly Asp Glu Glu Ile Lys Glu Phe Lys Lys Ser Val Leu
 35 40 45
 Tyr Phe Ile Leu Ser Gln Arg Tyr Ala Ile Thr Leu His Gln Asn Pro
 50 55 60
 Asn Glu Phe Ser Asp Leu Val Phe Ser Asn Pro Leu Gly Ala Ala Arg
 65 70 75 80
 Lys Ile Leu Ser Tyr Gln Asn Thr Lys Arg Val Phe Tyr Thr Gly Glu
 85 90 95
 Asn Glu Ser Pro Asn Phe Asn Leu Phe Asp Tyr Ala Ile Gly Phe Asp
 100 105 110
 Glu Leu Asp Phe Asn Asp Arg Tyr Leu Arg Met Pro Leu Tyr Tyr Ala
 115 120 125
 His Leu His Tyr Lys Ala Glu Leu Val Asn Asp Thr Thr Ala Pro Tyr
 130 135 140
 Lys Leu Lys Asp Asn Ser Leu Tyr Ala Leu Lys Lys Pro Ser His His
 145 150 155 160
 Phe Lys Glu Asn His Pro Asn Leu Cys Ala Val Val Asn Asp Glu Ser
 165 170 175
 Asp Leu Leu Lys Arg Gly Phe Ala Ser Phe Val Ala Ser Asn Ala Asn
 180 185 190
 Ala Pro Met Arg Asn Ala Phe Tyr Asp Ala Leu Asn Ser Ile Glu Pro
 195 200 205
 Val Thr Gly Gly Gly Ser Val Arg Asn Thr Leu Gly Tyr Lys Val Gly
 210 215 220
 Asn Lys Ser Glu Phe Leu Ser Gln Tyr Lys Phe Asn Leu Cys Phe Glu
 225 230 235 240
 Asn Ser Gln Gly Tyr Gly Tyr Val Thr Glu Lys Ile Leu Asp Ala Tyr
 245 250 255
 Phe Ser His Thr Ile Pro Ile Tyr Trp Gly Ser Pro Ser Val Ala Lys
 260 265 270

Asp Phe Asn Pro Lys Ser Phe Val Asn Val His Asp Phe Asn Asn Phe
 275 280 285
 Asp Glu Ala Ile Asp Tyr Ile Lys Tyr Leu His Thr His Pro Asn Ala
 290 295 300
 Tyr Leu Asp Met Leu Tyr Glu Asn Pro Leu Asn Thr Leu Asp Gly Lys
 305 310 315 320
 Ala Tyr Phe Tyr Gln Asp Leu Ser Phe Lys Lys Ile Leu Asp Phe Phe
 325 330 335
 Lys Thr Ile Leu Glu Asn Asp Thr Ile Tyr His Lys Phe Ser Thr Ser
 340 345 350
 Phe Met Trp Glu Tyr Asp Leu His Lys Pro Leu Val Ser Ile Asp Asp
 355 360 365
 Leu Arg Val Asn Tyr Asp Asp Leu Arg Val Asn Tyr Asp Arg Leu Leu
 370 375 380
 Gln Asn Ala Ser Pro Leu Leu Glu Leu Ser Gln Asn Thr Thr Phe Lys
 385 390 395 400
 Ile Tyr Arg Lys Ala Tyr Gln Lys Ser Leu Pro Leu Leu Arg Ala Val
 405 410 415
 Arg Lys Leu Val Lys Lys Leu Gly Leu
 420 425

<210> 13
 <211> 45
 <212> DNA
 <213> Helicobacter pylori

<220>
 <223> Helicobacter pylori strain 19C2 FutA
 alpha-1,3/4-fucosyltransferase

<400> 13
 atgttccaac ccttactaga cgcctttata gaaagtgtc caatt

45

<210> 14
 <211> 15
 <212> PRT
 <213> Helicobacter pylori

<220>
 <223> Helicobacter pylori strain 19C2 FutA
 alpha-1,3/4-fucosyltransferase

<400> 14
 Met Phe Gln Pro Leu Leu Asp Ala Phe Ile Glu Ser Ala Pro Ile
 1 5 10 15

<210> 15
 <211> 283
 <212> PRT
 <213> *Helicobacter pylori*

 <220>
 <223> *Helicobacter pylori* strain 1182 FutB
 alpha-1,3/4-fucosyltransferase amino acids 23-305,
 conserved fucosyltransferase catalytic domain

 <400> 15
 Pro Pro Pro Leu Lys Ile Ala Val Ala Asn Trp Trp Gly Asp Glu Glu
 1 5 10 15
 Val Glu Glu Phe Lys Lys Asn Ile Leu Tyr Phe Ile Leu Ser Gln His
 20 25 30
 Tyr Thr Ile Thr Leu His Gln Asn Pro Asn Glu Pro Ser Asp Leu Val
 35 40 45
 Phe Gly Ser Pro Ile Gly Ser Ala Arg Lys Ile Leu Ser Tyr Gln Asn
 50 55 60
 Ala Lys Arg Val Phe Tyr Thr Gly Glu Asn Glu Ser Pro Asn Phe Asn
 65 70 75 80
 Leu Phe Asp Tyr Ala Ile Gly Phe Asp Glu Leu Asp Phe Arg Asp Arg
 85 90 95
 Tyr Leu Arg Met Pro Leu Tyr Tyr Asp Arg Leu His His Lys Ala Glu
 100 105 110
 Ser Val Asn Asp Thr Thr Ser Pro Tyr Lys Leu Lys Pro Asp Ser Leu
 115 120 125
 Tyr Ala Leu Lys Lys Pro Ser His His Phe Lys Glu Asn His Pro Asn
 130 135 140
 Leu Cys Ala Val Val Asn Asn Glu Ser Asp Pro Leu Lys Arg Gly Phe
 145 150 155 160
 Ala Ser Phe Val Ala Ser Asn Pro Asn Ala Pro Lys Arg Asn Ala Phe
 165 170 175
 Tyr Asp Val Leu Asn Ser Ile Glu Pro Val Ile Gly Gly Gly Ser Val
 180 185 190
 Lys Asn Thr Leu Gly Tyr Asn Ile Lys Asn Lys Ser Glu Phe Leu Ser
 195 200 205
 Gln Tyr Lys Phe Asn Leu Cys Phe Glu Asn Ser Gln Gly Tyr Gly Tyr
 210 215 220
 Val Thr Glu Lys Ile Ile Asp Ala Tyr Phe Ser His Thr Ile Pro Ile
 225 230 235 240
 Tyr Trp Gly Ser Pro Ser Val Ala Gln Asp Phe Asn Pro Lys Ser Phe
 245 250 255

Val Asn Val Cys Asp Phe Lys Asp Phe Asp Glu Ala Ile Asp His Val
260 265 270

Arg Tyr Leu His Thr His Pro Asn Ala Tyr Leu
275 280

<210> 16
<211> 291
<212> PRT
<213> Artificial Sequence

<220>
<223> Description of Artificial Sequence:pfam00852,
Glyco_transf_10 consensus sequence from
glycosyltransferase family 10 fucosyltransferase
family

<400> 16
Thr Val Pro Leu Leu Leu Ala Ile Tyr Thr Trp Trp Ser Leu Ile Glu
1 5 10 15
Tyr Lys Glu Trp Lys Lys Ser Pro Ile Tyr Phe Ile Gly Ser Gln Ala
20 25 30
Pro Gln Pro Pro Leu Arg Ile Leu Leu Trp Thr Trp Pro Phe Asn Gly
35 40 45
Asn Pro Leu Ala Leu Ser Asp Cys Pro Leu Ser Tyr Gln Asn Thr Ala
50 55 60
Arg Cys Arg Leu Thr Ala Asn Arg Ser Pro Leu Glu Ser Ala Asp Ala
65 70 75 80
Val Leu Phe His His Arg Asp Leu Ser Lys Gly Phe Pro Asp Leu Pro
85 90 95
Pro Ser Pro Arg Pro Pro Gly Gln Pro Trp Val Trp Ala Ser Met Glu
100 105 110
Ser Pro Ser Asn Ser Gly Leu Asn Asp Leu Arg Asp Gly Tyr Phe Asn
115 120 125
Trp Thr Leu Ser Tyr Arg Ala Asp Ser Asp Ala Phe His Pro Tyr Gly
130 135 140
Tyr Leu Glu Pro Arg Leu Ser Gln Val Val Asn Ala Pro Leu Leu Ser
145 150 155 160
Ala Lys Arg Lys Gly Ala Ala Trp Val Val Ser Asn Cys Asn Thr Arg
165 170 175
Ser Lys Arg Glu Arg Phe Tyr Lys Gln Leu Asn Lys His Leu Gln Val
180 185 190
Asp Val Gly Gly Arg Val Ala Asn Pro Leu Pro Leu Lys Val Gly Cys
195 200 205
Leu Val Glu Thr Leu Ser Gln Tyr Lys Phe Tyr Leu Ala Phe Glu Asn
210 215 220

Ser Gln His Tyr Asp Tyr Val Thr Glu Lys Leu Trp Lys Asn Ala Leu
 225 230 235 240
 Gln Ala Gly Thr Ile Pro Val Val Leu Gly Pro Arg Ala Val Tyr Glu
 245 250 255
 Asp Phe Val Pro Pro Lys Ser Phe Ile His Val Asp Asp Phe Lys Ser
 260 265 270
 Pro Lys Glu Leu Ala Asp Tyr Leu Leu Tyr Leu Asp Thr Asn Pro Thr
 275 280 285
 Ala Tyr Ser
 290

<210> 17
 <211> 391
 <212> PRT
 <213> Helicobacter pylori

<220>
 <223> Helicobacter pylori strain 1111 FutA
 alpha-1,3/4-fucosyltransferase amino acids 27-417,
 conserved fucosyltransferase catalytic domain

<400> 17
 Ile Ala Val Ala Asn Trp Trp Gly Asp Glu Glu Ile Lys Lys Phe Lys
 1 5 10 15
 Lys Ser Val Leu Tyr Phe Ile Leu Ser Gln His Tyr Thr Ile Thr Leu
 20 25 30
 His Arg Asn Pro Asp Lys Pro Ala Asp Ile Val Phe Gly Asn Pro Leu
 35 40 45
 Gly Ser Ala Arg Lys Ile Leu Ser Tyr Gln Asn Ala Lys Arg Val Phe
 50 55 60
 Tyr Thr Gly Glu Asn Glu Val Pro Asn Phe Asn Leu Phe Asp Tyr Ala
 65 70 75 80
 Ile Gly Phe Asp Glu Leu Asp Phe Arg Asp Arg Tyr Leu Arg Met Pro
 85 90 95
 Leu Tyr Tyr Ala Tyr Leu His Tyr Lys Ala Glu Leu Val Asn Asp Thr
 100 105 110
 Thr Ser Pro Tyr Lys Leu Gln Pro Asp Ser Leu Tyr Ala Leu Lys Lys
 115 120 125
 Pro Ser His His Phe Lys Glu Asn His Pro Asn Leu Cys Ala Val Val
 130 135 140
 Asn Asn Glu Ser Asp Pro Leu Lys Arg Gly Phe Ala Ser Phe Val Ala
 145 150 155 160
 Ser Asn Pro Asn Ala Pro Arg Arg Asn Ala Phe Tyr Glu Ala Leu Asn
 165 170 175

Ala Ile Glu Pro Val Ala Gly Gly Gly Ser Val Lys Asn Thr Leu Gly
 180 185 190
 Tyr Asn Val Lys Asn Lys Ser Glu Phe Leu Ser Gln Tyr Lys Phe Asn
 195 200 205
 Leu Cys Phe Glu Asn Thr Gln Gly Tyr Gly Tyr Val Thr Glu Lys Ile
 210 215 220
 Ile Asp Ala Tyr Phe Ser His Thr Ile Pro Ile Tyr Trp Gly Ser Pro
 225 230 235 240
 Ser Val Ala Lys Asp Phe Asn Pro Lys Ser Phe Val Asn Val His Asp
 245 250 255
 Phe Asn Asn Phe Asp Glu Ala Ile Asp Tyr Ile Arg Tyr Leu His Thr
 260 265 270
 His Pro Asn Ala Tyr Leu Asp Met His Tyr Glu Asn Pro Leu Asn Thr
 275 280 285
 Ile Asp Gly Lys Ala Tyr Phe Tyr Gln Asn Leu Ser Phe Lys Lys Ile
 290 295 300
 Leu Asp Phe Phe Lys Thr Ile Leu Glu Asn Asp Thr Ile Tyr His Asp
 305 310 315 320
 Asn Pro Phe Ile Phe Tyr Arg Asp Leu Asn Glu Pro Ser Val Ser Ile
 325 330 335
 Asp Gly Leu Arg Val Asn Tyr Asp Asp Leu Arg Val Asn Tyr Asp Asp
 340 345 350
 Leu Arg Val Asn Tyr Asp Asp Leu Arg Val Asn Tyr Glu Arg Leu Leu
 355 360 365
 Gln Asn Ala Ser Pro Leu Leu Glu Leu Ser Gln Asn Thr Thr Phe Lys
 370 375 380
 Ile Tyr Arg Lys Ala Tyr Gln
 385 390

<210> 18

<211> 336

<212> PRT

<213> Artificial Sequence

<220>

<223> Description of Artificial Sequence:pfam00852,
 Glyco_transf_10 consensus sequence from
 glycosyltransferase family 10 fucosyltransferase
 family

<400> 18

Leu Ala Ile Tyr Thr Trp Trp Ser Leu Ile Glu Tyr Lys Glu Trp Lys
 1 5 10 15

Lys Ser Pro Ile Tyr Phe Ile Gly Ser Gln Ala Pro Gln Pro Pro Leu
 20 25 30

Arg Ile Leu Leu Trp Thr Trp Pro Phe Asn Gly Asn Pro Leu Ala Leu
 35 40 45
 Ser Asp Cys Pro Leu Ser Tyr Gln Asn Thr Ala Arg Cys Arg Leu Thr
 50 55 60
 Ala Asn Arg Ser Pro Leu Glu Ser Ala Asp Ala Val Leu Phe His His
 65 70 75 80
 Arg Asp Leu Ser Lys Gly Phe Pro Asp Leu Pro Pro Ser Pro Arg Pro
 85 90 95
 Pro Gly Gln Pro Trp Val Trp Ala Ser Met Glu Ser Pro Ser Asn Ser
 100 105 110
 Gly Leu Asn Asp Leu Arg Asp Gly Tyr Phe Asn Trp Thr Leu Ser Tyr
 115 120 125
 Arg Ala Asp Ser Asp Ala Phe His Pro Tyr Gly Tyr Leu Glu Pro Arg
 130 135 140
 Leu Ser Gln Val Val Asn Ala Pro Leu Leu Ser Ala Lys Arg Lys Gly
 145 150 155 160
 Ala Ala Trp Val Val Ser Asn Cys Asn Thr Arg Ser Lys Arg Glu Arg
 165 170 175
 Phe Tyr Lys Gln Leu Asn Lys His Leu Gln Val Asp Val Gly Gly Arg
 180 185 190
 Val Ala Asn Pro Leu Pro Leu Lys Val Gly Cys Leu Val Glu Thr Leu
 195 200 205
 Ser Gln Tyr Lys Phe Tyr Leu Ala Phe Glu Asn Ser Gln His Tyr Asp
 210 215 220
 Tyr Val Thr Glu Lys Leu Trp Lys Asn Ala Leu Gln Ala Gly Thr Ile
 225 230 235 240
 Pro Val Val Leu Gly Pro Arg Ala Val Tyr Glu Asp Phe Val Pro Pro
 245 250 255
 Lys Ser Phe Ile His Val Asp Asp Phe Lys Ser Pro Lys Glu Leu Ala
 260 265 270
 Asp Tyr Leu Leu Tyr Leu Asp Thr Asn Pro Thr Ala Tyr Ser Glu Tyr
 275 280 285
 Phe Glu Trp Arg Tyr Asp Leu Arg Val Arg Leu Phe Ser Trp Asp Ala
 290 295 300
 Leu Arg Tyr Asp Glu Gly Phe Cys Arg Val Cys Arg Leu Leu Gln Asn
 305 310 315 320
 Ala Pro Asp Arg Tyr Lys Thr Tyr Pro Asn Ile Ala Lys Trp Phe Gln
 325 330 335

<210> 19
 <211> 377
 <212> PRT
 <213> Helicobacter pylori

<220>
 <223> Helicobacter pylori strain 1218 FutB
 alpha-1,3/4-fucosyltransferase amino acids 23-399,
 conserved fucosyltransferase catalytic domain

<400> 19
 Pro Pro Pro Leu Lys Ile Ala Val Ala Asn Trp Trp Gly Asp Glu Glu
 1 5 10 15
 Val Glu Glu Phe Lys Lys Asn Ile Leu Tyr Phe Ile Leu Ser Gln His
 20 25 30
 Tyr Thr Ile Thr Leu His Gln Asn Pro Asn Glu Pro Ser Asp Leu Val
 35 40 45
 Phe Gly Ser Pro Ile Gly Ser Ala Arg Lys Ile Leu Ser Tyr Gln Asn
 50 55 60
 Ala Lys Arg Val Phe Tyr Thr Gly Glu Asn Glu Ser Pro Asn Phe Asn
 65 70 75 80
 Leu Phe Asp Tyr Ala Ile Gly Phe Asp Glu Leu Asp Phe Arg Asp Arg
 85 90 95
 Tyr Leu Arg Met Pro Leu Tyr Tyr Asp Arg Leu His His Lys Ala Glu
 100 105 110
 Ser Val Asn Asp Thr Thr Ser Pro Tyr Lys Leu Lys Pro Asp Ser Leu
 115 120 125
 Tyr Ala Leu Lys Lys Pro Ser His His Phe Lys Glu Asn His Pro Asn
 130 135 140
 Leu Cys Ala Val Val Asn Asn Glu Ser Asp Pro Leu Lys Arg Gly Phe
 145 150 155 160
 Ala Ser Phe Val Ala Ser Asn Pro Asn Ala Pro Lys Arg Asn Ala Phe
 165 170 175
 Tyr Asp Ala Leu Asn Ser Ile Glu Pro Val Ile Gly Gly Gly Ser Val
 180 185 190
 Lys Asn Thr Leu Gly Tyr Asn Ile Lys Asn Lys Ser Glu Phe Leu Ser
 195 200 205
 Gln Tyr Lys Phe Asn Leu Cys Phe Glu Asn Ser Gln Gly Tyr Gly Tyr
 210 215 220
 Val Thr Glu Lys Ile Ile Asp Ala Tyr Phe Ser His Thr Ile Pro Ile
 225 230 235 240
 Tyr Trp Gly Ser Pro Ser Val Ala Gln Asp Phe Asn Pro Lys Ser Phe
 245 250 255
 Val Asn Val Cys Asp Phe Lys Asp Phe Asp Glu Ala Ile Asp His Val
 260 265 270

Arg Tyr Leu His Thr His Pro Asn Ala Tyr Leu Asp Met Leu Tyr Glu
275 280 285

Asn Pro Leu Asn Thr Leu Asp Gly Lys Ala Tyr Phe Tyr Gln Asn Leu
290 295 300

Ser Phe Lys Lys Ile Leu Asp Phe Phe Lys Thr Ile Leu Glu Asn Asp
305 310 315 320

Thr Ile Tyr His Asp Asn Pro Phe Ile Phe Tyr Arg Asp Leu Asn Glu
325 330 335

Pro Leu Ile Ser Ile Asp Asp Leu Arg Val Asn Tyr Asp Asp Leu Arg
340 345 350

Val Asn Tyr Asp Asp Leu Arg Val Asn Tyr Asp Asp Leu Arg Val Asn
355 360 365

Tyr Asp Asp Leu Arg Val Asn Tyr Asp
370 375

<210> 20
<211> 341
<212> PRT
<213> Artificial Sequence

<220>
<223> Description of Artificial Sequence:pfam00852,
Glyco_transf_10 consensus sequence from
glycosyltransferase family 10 fucosyltransferase
family

<400> 20
Thr Val Pro Leu Leu Leu Ala Ile Tyr Thr Trp Trp Ser Leu Ile Glu
1 5 10 15

Tyr Lys Glu Trp Lys Lys Ser Pro Ile Tyr Phe Ile Gly Ser Gln Ala
20 25 30

Pro Gln Pro Pro Leu Arg Ile Leu Leu Trp Thr Trp Pro Phe Asn Gly
35 40 45

Asn Pro Leu Ala Leu Ser Asp Cys Pro Leu Ser Tyr Gln Asn Thr Ala
50 55 60

Arg Cys Arg Leu Thr Ala Asn Arg Ser Pro Leu Glu Ser Ala Asp Ala
65 70 75 80

Val Leu Phe His His Arg Asp Leu Ser Lys Gly Phe Pro Asp Leu Pro
85 90 95

Pro Ser Pro Arg Pro Pro Gly Gln Pro Trp Val Trp Ala Ser Met Glu
100 105 110

Ser Pro Ser Asn Ser Gly Leu Asn Asp Leu Arg Asp Gly Tyr Phe Asn
115 120 125

Trp Thr Leu Ser Tyr Arg Ala Asp Ser Asp Ala Phe His Pro Tyr Gly
130 135 140

Tyr Leu Glu Pro Arg Leu Ser Gln Val Val Asn Ala Pro Leu Leu Ser
 145 150 155 160
 Ala Lys Arg Lys Gly Ala Ala Trp Val Val Ser Asn Cys Asn Thr Arg
 165 170 175
 Ser Lys Arg Glu Arg Phe Tyr Lys Gln Leu Asn Lys His Leu Gln Val
 180 185 190
 Asp Val Gly Gly Arg Val Ala Asn Pro Leu Pro Leu Lys Val Gly Cys
 195 200 205
 Leu Val Glu Thr Leu Ser Gln Tyr Lys Phe Tyr Leu Ala Phe Glu Asn
 210 215 220
 Ser Gln His Tyr Asp Tyr Val Thr Glu Lys Leu Trp Lys Asn Ala Leu
 225 230 235 240
 Gln Ala Gly Thr Ile Pro Val Val Leu Gly Pro Arg Ala Val Tyr Glu
 245 250 255
 Asp Phe Val Pro Pro Lys Ser Phe Ile His Val Asp Asp Phe Lys Ser
 260 265 270
 Pro Lys Glu Leu Ala Asp Tyr Leu Leu Tyr Leu Asp Thr Asn Pro Thr
 275 280 285
 Ala Tyr Ser Glu Tyr Phe Glu Trp Arg Tyr Asp Leu Arg Val Arg Leu
 290 295 300
 Phe Ser Trp Asp Ala Leu Arg Tyr Asp Glu Gly Phe Cys Arg Val Cys
 305 310 315 320
 Arg Leu Leu Gln Asn Ala Pro Asp Arg Tyr Lys Thr Tyr Pro Asn Ile
 325 330 335
 Ala Lys Trp Phe Gln
 340

<210> 21
 <211> 256
 <212> PRT
 <213> Helicobacter pylori

<220>
 <223> Helicobacter pylori strain 19C2 FutB
 alpha-1,3/4-fucosyltransferase amino acids 23-377,
 conserved fucosyltransferase catalytic domain

<400> 21
 Pro Pro Leu Asn Ile Ala Leu Ala Asn Trp Trp Pro Leu Asp Lys Arg
 1 5 10 15
 Glu Ser Lys Gly Phe Arg Lys Lys Phe Ile Leu His Phe Ile Leu Ser
 20 25 30
 Gln His Tyr Thr Ile Ala Leu His Arg Asn Pro Asp Lys Pro Ala Asp
 35 40 45

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Ile Val Phe Gly Asn Pro Leu Gly Ser Ala Arg Lys Ile Leu Ser Tyr
  50              55              60

Gln Asn Ala Lys Arg Val Phe Tyr Thr Gly Glu Asn Glu Val Pro Asn
  65              70              75              80

Phe Asn Leu Phe Asp Tyr Ala Ile Gly Phe Asp Glu Leu Asp Phe Arg
              85              90              95

Asp Arg Tyr Leu Arg Met Pro Leu Tyr Tyr Asp Arg Leu His His Lys
      100              105              110

Ala Glu Ser Val Asn Asp Thr Thr Ala Pro Tyr Lys Ile Lys Ser Asp
      115              120              125

Ser Leu Tyr Ala Leu Lys Lys Pro Ser His His Phe Lys Glu Asn His
      130              135              140

Pro His Leu Cys Ala Leu Ile Asn Asn Glu Ile Asp Pro Leu Lys Arg
      145              150              155              160

Gly Phe Ala Ser Phe Val Ala Ser Asn Pro Asn Ala Pro Ile Arg Asn
              165              170              175

Ala Phe Tyr Glu Ala Leu Asn Ser Ile Glu Pro Val Thr Gly Gly Gly
      180              185              190

Ser Val Arg Asn Thr Leu Gly Tyr Asn Val Lys Asn Lys Asn Glu Phe
      195              200              205

Leu Ser Gln Tyr Lys Phe Asn Leu Cys Phe Glu Asn Thr Gln Gly Tyr
      210              215              220

Gly Tyr Val Thr Glu Lys Ile Ile Asp Ala Tyr Phe Ser His Thr Ile
      225              230              235              240

Pro Ile Tyr Trp Gly Gly Val Pro Ser Val Ala Lys Asp Phe Asn Pro
      245              250              255

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<210> 22
<211> 259
<212> PRT
<213> Artificial Sequence

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<220>
<223> Description of Artificial Sequence:pfam00852,
      Glyco_transf_10 consensus sequence from
      glycosyltransferase family 10 fucosyltransferase
      family

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<400> 22
Val Pro Leu Leu Leu Ala Ile Tyr Thr Trp Trp Ser Leu Ile Glu Tyr
  1              5              10              15

Lys Glu Trp Lys Lys Ser Pro Ile Tyr Phe Ile Gly Ser Gln Ala Pro
      20              25              30

Gln Pro Pro Leu Arg Ile Leu Leu Trp Thr Trp Pro Phe Asn Gly Asn
      35              40              45

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Pro Leu Ala Leu Ser Asp Cys Pro Leu Ser Tyr Gln Asn Thr Ala Arg
 50 55 60
 Cys Arg Leu Thr Ala Asn Arg Ser Pro Leu Glu Ser Ala Asp Ala Val
 65 70 75 80
 Leu Phe His His Arg Asp Leu Ser Lys Gly Phe Pro Asp Leu Pro Pro
 85 90 95
 Ser Pro Arg Pro Pro Gly Gln Pro Trp Val Trp Ala Ser Met Glu Ser
 100 105 110
 Pro Ser Asn Ser Gly Leu Asn Asp Leu Arg Asp Gly Tyr Phe Asn Trp
 115 120 125
 Thr Leu Ser Tyr Arg Ala Asp Ser Asp Ala Phe His Pro Tyr Gly Tyr
 130 135 140
 Leu Glu Pro Arg Leu Ser Gln Val Val Asn Ala Pro Leu Leu Ser Ala
 145 150 155 160
 Lys Arg Lys Gly Ala Ala Trp Val Val Ser Asn Cys Asn Thr Arg Ser
 165 170 175
 Lys Arg Glu Arg Phe Tyr Lys Gln Leu Asn Lys His Leu Gln Val Asp
 180 185 190
 Val Gly Gly Arg Val Ala Asn Pro Leu Pro Leu Lys Val Gly Cys Leu
 195 200 205
 Val Glu Thr Leu Ser Gln Tyr Lys Phe Tyr Leu Ala Phe Glu Asn Ser
 210 215 220
 Gln His Tyr Asp Tyr Val Thr Glu Lys Leu Trp Lys Asn Ala Leu Gln
 225 230 235 240
 Ala Gly Thr Ile Pro Val Val Leu Gly Pro Arg Ala Val Tyr Glu Asp
 245 250 255

Phe Val Pro

<210> 23
 <211> 245
 <212> PRT
 <213> Helicobacter pylori

<220>
 <223> Helicobacter pylori strain 1111 FutA
 alpha-1,3/4-fucosyltransferase

<400> 23
 Met Phe Gln Pro Leu Leu Asp Ala Phe Ile Glu Ser Ala Pro Leu Lys
 1 5 10 15
 Lys Trp Pro Leu Asn Leu Pro Pro Leu Lys Ile Ala Val Ala Asn Trp
 20 25 30
 Trp Gly Asp Glu Glu Ile Lys Lys Phe Lys Lys Ser Val Leu Tyr Phe
 35 40 45

Ile Leu Ser Gln His Tyr Thr Ile Thr Leu His Arg Asn Pro Asp Lys
 50 55 60
 Pro Ala Asp Ile Val Phe Gly Asn Pro Leu Gly Ser Ala Arg Lys Ile
 65 70 75 80
 Leu Ser Tyr Gln Asn Ala Lys Arg Val Phe Tyr Thr Gly Glu Asn Glu
 85 90 95
 Val Pro Asn Phe Asn Leu Phe Asp Tyr Ala Ile Gly Phe Asp Glu Leu
 100 105 110
 Asp Phe Arg Asp Arg Tyr Leu Arg Met Pro Leu Tyr Tyr Ala Tyr Leu
 115 120 125
 His Tyr Lys Ala Glu Leu Val Asn Asp Thr Thr Ser Pro Tyr Lys Leu
 130 135 140
 Gln Pro Asp Ser Leu Tyr Ala Leu Lys Lys Pro Ser His His Phe Lys
 145 150 155 160
 Glu Asn His Pro Asn Leu Cys Ala Val Val Asn Asn Glu Ser Asp Pro
 165 170 175
 Leu Lys Arg Gly Phe Ala Ser Phe Val Ala Ser Asn Pro Asn Ala Pro
 180 185 190
 Arg Arg Asn Ala Phe Tyr Glu Ala Leu Asn Ala Ile Glu Pro Val Ala
 195 200 205
 Gly Gly Gly Ser Val Lys Asn Thr Leu Gly Tyr Asn Val Lys Asn Lys
 210 215 220
 Ser Glu Phe Leu Ser Gln Tyr Lys Phe Asn Leu Cys Phe Glu Asn Thr
 225 230 235 240
 Gln Gly Tyr Gly Tyr
 245

<210> 24
 <211> 247
 <212> PRT
 <213> *Helicobacter pylori*

<220>
 <223> *Helicobacter pylori* strain 26695 FutA
 alpha-1,3/4-fucosyltransferase

<400> 24
 Met Phe Gln Pro Leu Leu Asp Ala Phe Ile Glu Ser Ala Ser Ile Glu
 1 5 10 15
 Lys Met Ala Ser Lys Ser Pro Pro Pro Pro Leu Lys Ile Ala Val Ala
 20 25 30
 Asn Trp Trp Gly Asp Glu Glu Ile Lys Glu Phe Lys Lys Ser Val Leu
 35 40 45
 Tyr Phe Ile Leu Ser Gln Arg Tyr Ala Ile Thr Leu His Gln Asn Pro
 50 55 60

Asn Glu Phe Ser Asp Leu Val Phe Ser Asn Pro Leu Gly Ala Ala Arg
 65 70 75 80
 Lys Ile Leu Ser Tyr Gln Asn Thr Lys Arg Val Phe Tyr Thr Gly Glu
 85 90 95
 Asn Glu Ser Pro Asn Phe Asn Leu Phe Asp Tyr Ala Ile Gly Phe Asp
 100 105 110
 Glu Leu Asp Phe Asn Asp Arg Tyr Leu Arg Met Pro Leu Tyr Tyr Ala
 115 120 125
 His Leu His Tyr Lys Ala Glu Leu Val Asn Asp Thr Thr Ala Pro Tyr
 130 135 140
 Lys Leu Lys Asp Asn Ser Leu Tyr Ala Leu Lys Lys Pro Ser His His
 145 150 155 160
 Phe Lys Glu Asn His Pro Asn Leu Cys Ala Val Val Asn Asp Glu Ser
 165 170 175
 Asp Leu Leu Lys Arg Gly Phe Ala Ser Phe Val Ala Ser Asn Ala Asn
 180 185 190
 Ala Pro Met Arg Asn Ala Phe Tyr Asp Ala Leu Asn Ser Ile Glu Pro
 195 200 205
 Val Thr Gly Gly Gly Ser Val Arg Asn Thr Leu Gly Tyr Lys Val Gly
 210 215 220
 Asn Lys Ser Glu Phe Leu Ser Gln Tyr Lys Phe Asn Leu Cys Phe Glu
 225 230 235 240
 Asn Ser Gln Gly Tyr Gly Tyr
 245

<210> 25
 <211> 246
 <212> PRT
 <213> *Helicobacter pylori*

<220>
 <223> *Helicobacter pylori* strain 1182 FutB
 alpha-1,3/4-fucosyltransferase

<400> 25
 Met Phe Gln Pro Leu Leu Asp Ala Tyr Ile Glu Ser Ala Ser Ile Glu
 1 5 10 15
 Lys Ile Thr Ser Lys Ser Pro Pro Pro Leu Lys Ile Ala Val Ala Asn
 20 25 30
 Trp Trp Gly Asp Glu Glu Val Glu Glu Phe Lys Lys Asn Ile Leu Tyr
 35 40 45
 Phe Ile Leu Ser Gln His Tyr Thr Ile Thr Leu His Gln Asn Pro Asn
 50 55 60
 Glu Pro Ser Asp Leu Val Phe Gly Ser Pro Ile Gly Ser Ala Arg Lys
 65 70 75 80

Ile Leu Ser Tyr Gln Asn Ala Lys Arg Val Phe Tyr Thr Gly Glu Asn
 85 90 95
 Glu Ser Pro Asn Phe Asn Leu Phe Asp Tyr Ala Ile Gly Phe Asp Glu
 100 105 110
 Leu Asp Phe Arg Asp Arg Tyr Leu Arg Met Pro Leu Tyr Tyr Asp Arg
 115 120 125
 Leu His His Lys Ala Glu Ser Val Asn Asp Thr Thr Ser Pro Tyr Lys
 130 135 140
 Leu Lys Pro Asp Ser Leu Tyr Ala Leu Lys Lys Pro Ser His His Phe
 145 150 155 160
 Lys Glu Asn His Pro Asn Leu Cys Ala Val Val Asn Asn Glu Ser Asp
 165 170 175
 Pro Leu Lys Arg Gly Phe Ala Ser Phe Val Ala Ser Asn Pro Asn Ala
 180 185 190
 Pro Lys Arg Asn Ala Phe Tyr Asp Val Leu Asn Ser Ile Glu Pro Val
 195 200 205
 Ile Gly Gly Gly Ser Val Lys Asn Thr Leu Gly Tyr Asn Ile Lys Asn
 210 215 220
 Lys Ser Glu Phe Leu Ser Gln Tyr Lys Phe Asn Leu Cys Phe Glu Asn
 225 230 235 240
 Ser Gln Gly Tyr Gly Tyr
 245

<210> 26
 <211> 246
 <212> PRT
 <213> *Helicobacter pylori*

<220>
 <223> *Helicobacter pylori* strain 1218 FutB
 alpha-1,3/4-fucosyltransferase

<400> 26
 Met Phe Gln Pro Leu Leu Asp Ala Tyr Ile Glu Ser Ala Ser Ile Glu
 1 5 10 15
 Lys Ile Thr Ser Lys Ser Pro Pro Pro Leu Lys Ile Ala Val Ala Asn
 20 25 30
 Trp Trp Gly Asp Glu Glu Val Glu Glu Phe Lys Lys Asn Ile Leu Tyr
 35 40 45
 Phe Ile Leu Ser Gln His Tyr Thr Ile Thr Leu His Gln Asn Pro Asn
 50 55 60
 Glu Pro Ser Asp Leu Val Phe Gly Ser Pro Ile Gly Ser Ala Arg Lys
 65 70 75 80
 Ile Leu Ser Tyr Gln Asn Ala Lys Arg Val Phe Tyr Thr Gly Glu Asn
 85 90 95

Glu Ser Pro Asn Phe Asn Leu Phe Asp Tyr Ala Ile Gly Phe Asp Glu
 100 105 110
 Leu Asp Phe Arg Asp Arg Tyr Leu Arg Met Pro Leu Tyr Tyr Asp Arg
 115 120 125
 Leu His His Lys Ala Glu Ser Val Asn Asp Thr Thr Ser Pro Tyr Lys
 130 135 140
 Leu Lys Pro Asp Ser Leu Tyr Ala Leu Lys Lys Pro Ser His His Phe
 145 150 155 160
 Lys Glu Asn His Pro Asn Leu Cys Ala Val Val Asn Asn Glu Ser Asp
 165 170 175
 Pro Leu Lys Arg Gly Phe Ala Ser Phe Val Ala Ser Asn Pro Asn Ala
 180 185 190
 Pro Lys Arg Asn Ala Phe Tyr Asp Ala Leu Asn Ser Ile Glu Pro Val
 195 200 205
 Ile Gly Gly Gly Ser Val Lys Asn Thr Leu Gly Tyr Asn Ile Lys Asn
 210 215 220
 Lys Ser Glu Phe Leu Ser Gln Tyr Lys Phe Asn Leu Cys Phe Glu Asn
 225 230 235 240
 Ser Gln Gly Tyr Gly Tyr
 245

<210> 27
 <211> 247
 <212> PRT
 <213> *Helicobacter pylori*

<220>
 <223> *Helicobacter pylori* strain 19C2 FutB
 alpha-1,3/4-fucosyltransferase

<400> 27
 Met Phe Gln Pro Leu Leu Asp Ala Tyr Ile Asp Ser Thr Arg Leu Asp
 1 5 10 15
 Glu Thr Asp Tyr Lys Pro Pro Leu Asn Ile Ala Leu Ala Asn Trp Trp
 20 25 30
 Pro Leu Asp Lys Arg Glu Ser Lys Gly Phe Arg Lys Lys Phe Ile Leu
 35 40 45
 His Phe Ile Leu Ser Gln His Tyr Thr Ile Ala Leu His Arg Asn Pro
 50 55 60
 Asp Lys Pro Ala Asp Ile Val Phe Gly Asn Pro Leu Gly Ser Ala Arg
 65 70 75 80
 Lys Ile Leu Ser Tyr Gln Asn Ala Lys Arg Val Phe Tyr Thr Gly Glu
 85 90 95
 Asn Glu Val Pro Asn Phe Asn Leu Phe Asp Tyr Ala Ile Gly Phe Asp
 100 105 110

Glu Leu Asp Phe Arg Asp Arg Tyr Leu Arg Met Pro Leu Tyr Tyr Asp
 115 120 125
 Arg Leu His His Lys Ala Glu Ser Val Asn Asp Thr Thr Ala Pro Tyr
 130 135 140
 Lys Ile Lys Ser Asp Ser Leu Tyr Ala Leu Lys Lys Pro Ser His His
 145 150 155 160
 Phe Lys Glu Asn His Pro His Leu Cys Ala Leu Ile Asn Asn Glu Ile
 165 170 175
 Asp Pro Leu Lys Arg Gly Phe Ala Ser Phe Val Ala Ser Asn Pro Asn
 180 185 190
 Ala Pro Ile Arg Asn Ala Phe Tyr Glu Ala Leu Asn Ser Ile Glu Pro
 195 200 205
 Val Thr Gly Gly Gly Ser Val Arg Asn Thr Leu Gly Tyr Asn Val Lys
 210 215 220
 Asn Lys Asn Glu Phe Leu Ser Gln Tyr Lys Phe Asn Leu Cys Phe Glu
 225 230 235 240
 Asn Thr Gln Gly Tyr Gly Tyr
 245

<210> 28
 <211> 13
 <212> PRT
 <213> Artificial Sequence

<220>
 <223> Description of Artificial Sequence:Helicobacter
 pylori alpha-1,3/4-fucosyltransferase consensus
 sequence

<400> 28
 Met Phe Gln Pro Leu Leu Asp Ala Phe Ile Glu Ser Ala
 1 5 10

<210> 29
 <211> 16
 <212> PRT
 <213> Artificial Sequence

<220>
 <223> Description of Artificial Sequence:Helicobacter
 pylori alpha-1,3/4-fucosyltransferase consensus
 sequence

<400> 29
 Pro Pro Leu Lys Ile Ala Val Ala Asn Trp Trp Gly Asp Glu Glu Ile
 1 5 10 15

<210> 30
<211> 15
<212> PRT
<213> Artificial Sequence

<220>
<223> Description of Artificial Sequence:Helicobacter
pylori alpha-1,3/4-fucosyltransferase consensus
sequence

<400> 30
Ile Leu Tyr Phe Ile Leu Ser Gln His Tyr Thr Ile Thr Leu His
1 5 10 15

<210> 31
<211> 32
<212> PRT
<213> Artificial Sequence

<220>
<223> Description of Artificial Sequence:Helicobacter
pylori alpha-1,3/4-fucosyltransferase consensus
sequence

<400> 31
Pro Ala Asp Ile Val Phe Gly Asn Pro Leu Gly Ser Ala Arg Lys Ile
1 5 10 15

Leu Ser Tyr Gln Asn Ala Lys Arg Val Phe Tyr Thr Gly Glu Asn Glu
20 25 30

<210> 32
<211> 28
<212> PRT
<213> Artificial Sequence

<220>
<223> Description of Artificial Sequence:Helicobacter
pylori alpha-1,3/4-fucosyltransferase consensus
sequence

<400> 32
Pro Asn Phe Asn Leu Phe Asp Tyr Ala Ile Gly Phe Asp Glu Leu Asp
1 5 10 15

Phe Arg Asp Arg Tyr Leu Arg Met Pro Leu Tyr Tyr
20 25

<210> 33
<211> 6
<212> PRT
<213> Artificial Sequence

<220>
<223> Description of Artificial Sequence:Helicobacter
pylori alpha-1,3/4-fucosyltransferase consensus
sequence

<400> 33
Leu His His Lys Ala Glu
1 5

<210> 34
<211> 11
<212> PRT
<213> Artificial Sequence

<220>
<223> Description of Artificial Sequence:Helicobacter
pylori alpha-1,3/4-fucosyltransferase consensus
sequence

<400> 34
Val Asn Asp Thr Thr Ser Pro Tyr Lys Leu Lys
1 5 10

<210> 35
<211> 46
<212> PRT
<213> Artificial Sequence

<220>
<223> Description of Artificial Sequence:Helicobacter
pylori alpha-1,3/4-fucosyltransferase consensus
sequence

<400> 35
Asp Ser Leu Tyr Ala Leu Lys Lys Pro Ser His His Phe Lys Glu Asn
1 5 10 15

His Pro Asn Leu Cys Ala Val Val Asn Asn Glu Ser Asp Pro Leu Lys
20 25 30

Arg Gly Phe Ala Ser Phe Val Ala Ser Asn Pro Asn Ala Pro
35 40 45

<210> 36
<211> 14
<212> PRT
<213> Artificial Sequence

<220>
<223> Description of Artificial Sequence:Helicobacter
pylori alpha-1,3/4-fucosyltransferase consensus
sequence

<400> 36
Arg Asn Ala Phe Tyr Asp Ala Leu Asn Ser Ile Glu Pro Val
1 5 10

<210> 37
<211> 37
<212> PRT
<213> Artificial Sequence

<220>
 <223> Description of Artificial Sequence:Helicobacter pylori alpha-1,3/4-fucosyltransferase consensus sequence

<400> 37
 Gly Gly Gly Ser Val Lys Asn Thr Leu Gly Tyr Asn Val Lys Asn Lys
 1 5 10 15
 Ser Glu Phe Leu Ser Gln Tyr Lys Phe Asn Leu Cys Phe Glu Asn Ser
 20 25 30
 Gln Gly Tyr Gly Tyr
 35

<210> 38
 <211> 333
 <212> DNA
 <213> Helicobacter pylori

<220>
 <223> Helicobacter pylori strain 915 FutA (915A.cod (MWG)) alpha-1,3/4-fucosyltransferase

<400> 38
 atgttccaac ccctattaga tgcctttata gaaagcgctt ccattgaaaa aatggcctct 60
 aaatctcccc ccctaaaaat cgctgtggcg aattgggtggg gagatgaaga aattaaaaaa 120
 tttaaaaaga gcgttcttta tttatccta agccagcatt acacaatcac tttacaccga 180
 aacctgtata aacctgcgga catcgtcttt ggtaaccccc ttggatcagc cagaaaaatc 240
 ttatcctatc aaaacgcaaa aagggtgttt tacaccggtg aaaatgaagt ccctaacttc 300
 aacctctttg attacgccat aggcttttga tga 333

<210> 39
 <211> 53
 <212> DNA
 <213> Artificial Sequence

<220>
 <223> Description of Artificial Sequence:Helicobacter pylori alpha-1,3/4-fucosyltransferase consensus sequence

<400> 39
 atgttccaac ccctattaga cgcctttata gaaagcgctt ccattgaaaa aat 53

<210> 40
 <211> 20
 <212> DNA
 <213> Artificial Sequence

<220>
 <223> Description of Artificial Sequence:Helicobacter pylori alpha-1,3/4-fucosyltransferase consensus sequence

<400> 40
 gcctctaaat ctcccccccc 20

<210> 41
 <211> 26
 <212> DNA
 <213> Artificial Sequence

 <220>
 <223> Description of Artificial Sequence:Helicobacter
 pylori alpha-1,3/4-fucosyltransferase consensus
 sequence

 <400> 41
 taaaaatcgc tgtggcgaat tggtagg 26

 <210> 42
 <211> 23
 <212> DNA
 <213> Artificial Sequence

 <220>
 <223> Description of Artificial Sequence:Helicobacter
 pylori alpha-1,3/4-fucosyltransferase consensus
 sequence

 <400> 42
 agaaattaaa gaatttaaaa aga 23

 <210> 43
 <211> 17
 <212> DNA
 <213> Artificial Sequence

 <220>
 <223> Description of Artificial Sequence:Helicobacter
 pylori alpha-1,3/4-fucosyltransferase consensus
 sequence

 <400> 43
 cagcattaca caatcac 17

 <210> 44
 <211> 10
 <212> DNA
 <213> Artificial Sequence

 <220>
 <223> Description of Artificial Sequence:Helicobacter
 pylori alpha-1,3/4-fucosyltransferase consensus
 sequence

 <400> 44
 tcgtcttttg 10

 <210> 45
 <211> 44
 <212> DNA
 <213> Artificial Sequence

<220>
 <223> Description of Artificial Sequence:Helicobacter pylori alpha-1,3/4-fucosyltransferase consensus sequence

<400> 45
 cttggatcag ccagaaaaat cttatcctat caaaacgcaa aaag 44

<210> 46
 <211> 24
 <212> DNA
 <213> Artificial Sequence

<220>
 <223> Description of Artificial Sequence:Helicobacter pylori alpha-1,3/4-fucosyltransferase consensus sequence

<400> 46
 gtgttttaca ccggtgaaaa cgaa 24

<210> 47
 <211> 36
 <212> DNA
 <213> Artificial Sequence

<220>
 <223> Description of Artificial Sequence:Helicobacter pylori alpha-1,3/4-fucosyltransferase consensus sequence

<400> 47
 cctaatttca acctctttga ttacgccata ggcttt 36

<210> 48
 <211> 11
 <212> DNA
 <213> Artificial Sequence

<220>
 <223> Description of Artificial Sequence:Helicobacter pylori alpha-1,3/4-fucosyltransferase consensus sequence

<400> 48
 gatgaattgg a 11

<210> 49
 <211> 17
 <212> DNA
 <213> Artificial Sequence

<220>
 <223> Description of Artificial Sequence:Helicobacter pylori alpha-1,3/4-fucosyltransferase consensus sequence

<400> 49 tttagagatc gttat	17
<210> 50 <211> 11 <212> DNA <213> Artificial Sequence	
<220> <223> Description of Artificial Sequence:Helicobacter pylori alpha-1,3/4-fucosyltransferase consensus sequence	
<400> 50 agaatgcctt t	11
<210> 51 <211> 11 <212> DNA <213> Artificial Sequence	
<220> <223> Description of Artificial Sequence:Helicobacter pylori alpha-1,3/4-fucosyltransferase consensus sequence	
<400> 51 ataaagccga g	11
<210> 52 <211> 12 <212> DNA <213> Artificial Sequence	
<220> <223> Description of Artificial Sequence:Helicobacter pylori alpha-1,3/4-fucosyltransferase consensus sequence	
<400> 52 aatgacacca ct	12
<210> 53 <211> 17 <212> DNA <213> Artificial Sequence	
<220> <223> Description of Artificial Sequence:Helicobacter pylori alpha-1,3/4-fucosyltransferase consensus sequence	
<400> 53 cgcttacaa actcaaa	17

<210> 54
 <211> 55
 <212> DNA
 <213> Artificial Sequence

 <220>
 <223> Description of Artificial Sequence:Helicobacter
 pylori alpha-1,3/4-fucosyltransferase consensus
 sequence

 <400> 54
 ctgacagcct ttatgcttta aaaaaaccct cccatcattt taaagaaaac caccc 55

 <210> 55
 <211> 14
 <212> DNA
 <213> Artificial Sequence

 <220>
 <223> Description of Artificial Sequence:Helicobacter
 pylori alpha-1,3/4-fucosyltransferase consensus
 sequence

 <400> 55
 tgcgcagtag tgaa 14

 <210> 56
 <211> 35
 <212> DNA
 <213> Artificial Sequence

 <220>
 <223> Description of Artificial Sequence:Helicobacter
 pylori alpha-1,3/4-fucosyltransferase consensus
 sequence

 <400> 56
 aatgagagcg atccttttgaa aagagggttt gcgag 35

 <210> 57
 <211> 19
 <212> DNA
 <213> Artificial Sequence

 <220>
 <223> Description of Artificial Sequence:Helicobacter
 pylori alpha-1,3/4-fucosyltransferase consensus
 sequence

 <400> 57
 agcaacccta acgctccta 19

 <210> 58
 <211> 14
 <212> DNA
 <213> Artificial Sequence

<220>
 <223> Description of Artificial Sequence:Helicobacter
 pylori alpha-1,3/4-fucosyltransferase consensus
 sequence

 <400> 58
 gcttttaaatt ctat 14

 <210> 59
 <211> 10
 <212> DNA
 <213> Artificial Sequence

 <220>
 <223> Description of Artificial Sequence:Helicobacter
 pylori alpha-1,3/4-fucosyltransferase consensus
 sequence

 <400> 59
 gagccagtta 10

 <210> 60
 <211> 17
 <212> DNA
 <213> Artificial Sequence

 <220>
 <223> Description of Artificial Sequence:Helicobacter
 pylori alpha-1,3/4-fucosyltransferase consensus
 sequence

 <400> 60
 tgggggaggg agcgtga 17

 <210> 61
 <211> 18
 <212> DNA
 <213> Artificial Sequence

 <220>
 <223> Description of Artificial Sequence:Helicobacter
 pylori alpha-1,3/4-fucosyltransferase consensus
 sequence

 <400> 61
 aaacacttta ggctataa 18

 <210> 62
 <211> 23
 <212> DNA
 <213> Artificial Sequence

 <220>
 <223> Description of Artificial Sequence:Helicobacter
 pylori alpha-1,3/4-fucosyltransferase consensus
 sequence

<400> 62	
agcgagtttt taagccaata caa	23
<210> 63	
<211> 21	
<212> DNA	
<213> Artificial Sequence	
<220>	
<223> Description of Artificial Sequence:Helicobacter pylori alpha-1,3/4-fucosyltransferase consensus sequence	
<400> 63	
ttcaatctgt gttttgaaaa c	21
<210> 64	
<211> 41	
<212> DNA	
<213> Artificial Sequence	
<220>	
<223> Description of Artificial Sequence:Helicobacter pylori alpha-1,3/4-fucosyltransferase consensus sequence	
<400> 64	
caaggctatg gctatgtaac tgaaaaaatc attgacgctt a	41
<210> 65	
<211> 27	
<212> DNA	
<213> Artificial Sequence	
<220>	
<223> Description of Artificial Sequence:Helicobacter pylori alpha-1,3/4-fucosyltransferase consensus sequence	
<400> 65	
agccatacca ttctatttta ttggggg	27
<210> 66	
<211> 16	
<212> DNA	
<213> Artificial Sequence	
<220>	
<223> Description of Artificial Sequence:Helicobacter pylori alpha-1,3/4-fucosyltransferase consensus sequence	
<400> 66	
aagattttaa ccctaa	16

<210> 67
 <211> 14
 <212> DNA
 <213> Artificial Sequence

 <220>
 <223> Description of Artificial Sequence:Helicobacter
 pylori alpha-1,3/4-fucosyltransferase consensus
 sequence

 <400> 67
 agttttgtga atgt 14

 <210> 68
 <211> 17
 <212> DNA
 <213> Artificial Sequence

 <220>
 <223> Description of Artificial Sequence:Helicobacter
 pylori alpha-1,3/4-fucosyltransferase consensus
 sequence

 <400> 68
 tttgatgaag cgattga 17

 <210> 69
 <211> 33
 <212> DNA
 <213> Artificial Sequence

 <220>
 <223> Description of Artificial Sequence:Helicobacter
 pylori alpha-1,3/4-fucosyltransferase consensus
 sequence

 <400> 69
 tgcacacgca cccaaacgct tatttagaca tgc 33

 <210> 70
 <211> 20
 <212> DNA
 <213> Artificial Sequence

 <220>
 <223> Description of Artificial Sequence:Helicobacter
 pylori alpha-1,3/4-fucosyltransferase consensus
 sequence

 <400> 70
 tatgaaaacc ctttaaacac 20

 <210> 71
 <211> 26
 <212> DNA
 <213> Artificial Sequence

<220>
 <223> Description of Artificial Sequence:Helicobacter
 pylori alpha-1,3/4-fucosyltransferase consensus
 sequence

<400> 71
 ttgatgggaa agcttacttt taccaa 26

<210> 72
 <211> 40
 <212> DNA
 <213> Artificial Sequence

<220>
 <223> Description of Artificial Sequence:Helicobacter
 pylori alpha-1,3/4-fucosyltransferase consensus
 sequence

<400> 72
 atttgagttt taaaaaaatc ctagattttt ttaaaacgat 40

<210> 73
 <211> 11
 <212> DNA
 <213> Artificial Sequence

<220>
 <223> Description of Artificial Sequence:Helicobacter
 pylori alpha-1,3/4-fucosyltransferase consensus
 sequence

<400> 73
 ttagaaaacg a 11

<210> 74
 <211> 38
 <212> DNA
 <213> Artificial Sequence

<220>
 <223> Description of Artificial Sequence:Helicobacter
 pylori alpha-1,3/4-fucosyltransferase consensus
 sequence

<400> 74
 ttgagggtta attatgatga tttgagggtt aattatga 38

<210> 75
 <211> 8
 <212> PRT
 <213> Artificial Sequence

<220>
 <223> Description of Artificial Sequence:FLAG tag
 epitope tag

<400> 75
Asp Tyr Lys Asp Asp Asp Asp Lys
1 5

<210> 76
<211> 6
<212> PRT
<213> Artificial Sequence

<220>
<223> Description of Artificial Sequence:hexahistidine
affinity tag, purification tag

<400> 76
His His His His His His
1 5